

REMOTELY SENSED SEA SURFACE TEMPERATURE

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Overview (1)

- Rationale
 - Weather
 - Climate
- Background
 - History
 - Algorithms
 - Quality



Overview (2)

- Pathfinder Results
 - Data Flow
 - Validation
 - Products

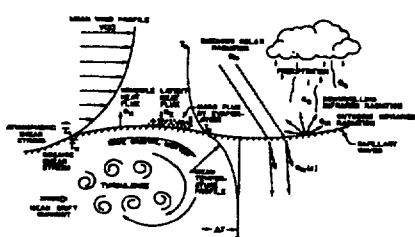


SST: Role in Ocean/Atmosphere System

- Primary mechanism for communicating ocean upper layer thermal state to atmosphere
 - Weather
 - Sea Breeze, Enhanced Convection
 - Explosive Cyclogenesis
 - Climate
 - Seasonal/Interannual (ENSO)
 - Decadal/Centennial (Conveyor Belt)



Ocean/Atmosphere Interaction

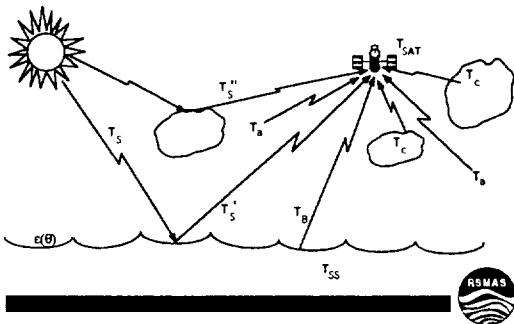


SST Estimation

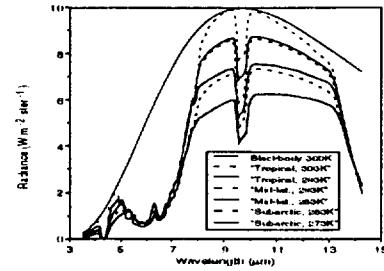
- In situ observations
 - Sampling (sparse)
 - Accuracy
- Remote sensing observations
 - Skin/Bulk correlation
 - Accuracy
 - Temporal sampling biases



Radiative Transfer Schematic L_{SAT}



Atmospheric Transmissivity



Radiative Transfer: Formal Relations

$$L_1 = L_1(ss) t_1(O, P_o) - \int_{P_o}^{P_o} B_1[T(P)] d\tau_1(O, P)$$

where L_1 is the radiance,

$t_1(O, P_x)$ the transmissivity from a pressure level P_x to the top of the atmosphere, and $B_1(T)$ the Planck function.

Infrared Correction Approaches

- Single-Channel (to 1981)
- Multi-Channel (1981)
 - MCSST 1981 - ...
 - CPSST 1990 - 1992
 - NLSST 1992 - ...
- ESA/ATSR
 - Dual Look 1992 - ...

Algorithm Structure

$$\text{MCSST} = a_0 + a_1 T_1 + a_2 T_2$$

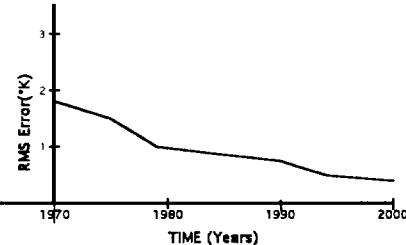
$$\text{CPSST} = (a_0 - a_1 T_4) / (a_2 + a_3 T_5 - a_6 T_4) \\ \times (a_7 + T_4 - T_5) + a_8 T_5$$

$$\text{NLSST} = a_0 + a_1 T_4 + a_2 (T_4 - T_5) T_c \\ + d_3 (\sec \vartheta - 1) (T_4 - T_5)$$

Background Infrared Remote Sensing

- HRIR: First low noise (Nimbus, 1966/72)
- VHRR: Operational 1 Km sensor (NOAA-2, 1972/79)
- OLS: Geometrical correction (DMSP, 1976-...)
- AVHRR: Prototype (TIROS-N, 1978/79)
- AVHRR/1: 3.7 μ band (NOAA-6, 1979/82)
- AVHRR/2: 3 bands (NOAA-7, 1981/89)
- ATSR: Conical Scan (ERS-1, 1992-...)

Retrieved SST RMS Error



Approach

- Examine AVHRR data retrievals
- Radiative Transfer modelling
- Cross-validation of model and *in situ* data
- Transfer AVHRR results to MODIS
- *In situ* algorithm development observations
- Post-launch satellite-*in situ* comparisons



SST Quality Issues

- Sensor Design
- Sensor Characterization
- RTE Models
- Inflight Monitoring
- Validation

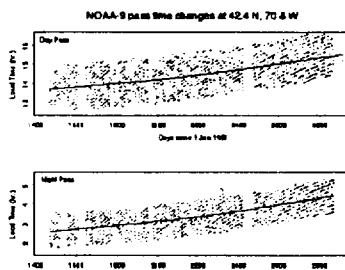


Validation

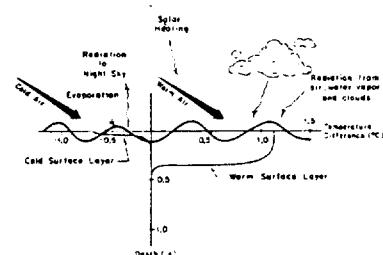
- Historically: Serendipitous
- MODIS
 - Opportunistic
 - Drifting Buoys
- Bulk vs. Skin Temperature



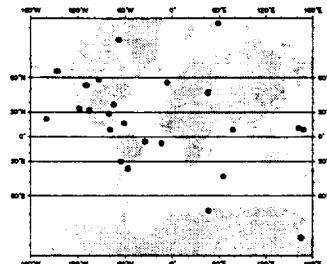
Validation: Diurnal Effects



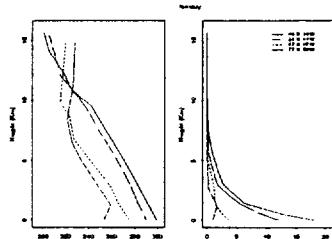
Skin vs. Bulk Effects



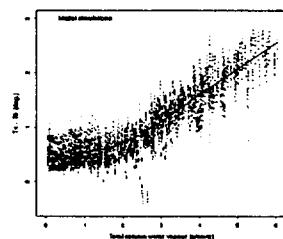
Profile Station Locations



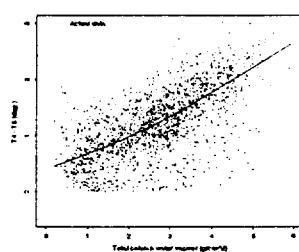
Simulation Profiles: January



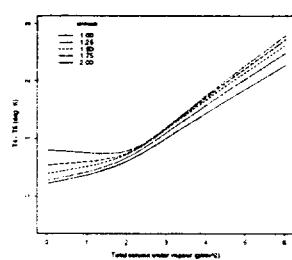
T_{45} dependence on Model WVapor



T_{45} dependence on SSMI WVapor



T_{45} / Water Vapor / Air Mass



T_{45} / Water Vapor Dependence

